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Motor Vehicle Tampering Survey - 1983

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The Environmental Protection Agency conducted a survey of 1,831 light-duty motor vehicles for tampering with emissions control devices. All vehicles inspected were classified into one of four mutually exclusive categories: tampered (at least one control device removed or rendered inoperative), arguably tampered (potential, but not clear-cut tampering), malfunctioning, and okay (all control devices present and apparently operating properly). The results were: tampered - 26%, arguably tampered - 30%, malfunctioning - 3%, and okay - 41%. The survey also found that 14 percent of the vehicles were subject to fuel switching (using leaded gas in vehicles requiring unleaded fuel).

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MOTOR VEHICLE TAMPERING SURVEY - 1983

July 1984

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INTRODUCTION

Under the direction of the Field Operations and Support Division (FOSD) of the EPA, personnel of both the EPA National Enforcement Investigations Center (NEIC) and FOSD conducted a survey of light duty motor vehicle tampering at six U.S. urban areas from September through December of 1983. The areas surveyed and total number of vehicles inspected are presented below:

Area inspected	Number of inspections
Cook Co., IL	268
Sedgwick Co., KA	290
Houston, TX	374
Denver, CO	332
Los Angeles, CA	270
Phoenix, AZ	297

Motor vehicle emissions in urbanized areas account for nearly 90% of the total carbon monoxide (CO) and airborne lead, over 50% of the hydrocarbons (HC), and nearly 40% of the oxides of nitrogen (NOx) emitted to the atmosphere. As a result, a major focus of the nation's effort to achieve compliance with clean air standards has been the control of emissions from mobile sources. In order to meet required emission standards, vehicle manufacturers have, since 1968, installed a variety of control devices on new vehicles.

The 1977 amendments to the Clean Air Act (sections 203(a)(3)(A) and (B), found in Appendix A) make it illegal for automobile dealers, repair and service facilities, and fleet operators to disconnect or render inoperative emission control devices or elements of design. The FOSD is responsible for enforcing the tampering provisions of this Act.

In order to determine the pattern and incidence of tampering and fuel

switching, a series of surveys were conducted in 1978[1], 1979[2], 1981[3], and 1982[4]. These surveys were conducted by the Mobile Source Enforcement Division (FOSD's predecessor organization), an expert automotive consultant, and NEIC. Consistent inspection procedures were used in all of these surveys to permit comparisons and identification of trends.

1983 Survey Objectives

In addition to the general focus of earlier surveys on identification of trends in rates and types of tampering, the 1983 survey is a principal measurement tool in an Agency program by which credit may be granted on State Implementation Plans (SIPs) for state and local measures to reduce emissions due to tampering and fuel switching. Data from the survey are used in a computer model (MOBILE3) along with engineering test results, to estimate both the emission loading impact of these behaviors and the reductions that may be achieved by various control program configurations. Sites for the survey were chosen in light of the need for data on specific areas considering programs, as well as the continuing need to monitor the general level and distribution of tampering and fuel switching in the nation.

Within resource limitations, the survey was designed to:

1. Make local measurements of type and extent of tampering and fuel switching for SIP credit purposes

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1 Motor Vehicle Tampering Survey (1978), U.S. Environmental Protection Agency, Mobile Source Enforcement Division, November 1978.

2 Motor Vehicle Tampering Survey (1979), U.S. Environmental Protection Agency, National Enforcement Investigations Center, May 1980, EPA-330/1-80-001.

3 Motor Vehicle Tampering Survey - 1981, Chattanooga, Tennessee and Houston, Texas, U.S. Environmental Protection Agency, National Enforcement Investigations Center, March 1982, EPA-330/1-82-001.

4 Motor Vehicle Tampering Survey - 1982, U.S. Environmental Protection Agency, National Enforcement Investigations Center, April 1983, EPA-330/1-83-001.

2. Extend and update the knowledge gained from earlier surveys on:

   a. Rates of overall and component-specific tampering and fuel switching

   b. Distribution of tampering by age and mileage of vehicle, manufacturer, and other variables of interest

   c. The effects of tampering on vehicle idle emissions

   d. The effect of vehicle inspection and maintenance (I/M) programs and anti-tampering programs on tampering and fuel switching behavior

In order to achieve these objectives, inspection teams visually examined emission control devices and performed measurements of idle CO and HC emissions. To provide information on fuel switching, inspectors sampled gasoline from the tanks of vehicles (for later laboratory analysis for lead), tested for lead deposits in tailpipes using Plumbtesmo® test paper, and checked the integrity of the fuel filler inlet restrictor. These brief but thorough inspections were performed with the consent of the vehicle owners in a variety of settings more fully detailed elsewhere in this report.

SUMMARY OF FINDINGS

The proportion of sampled vehicles with at least one tampered component is up significantly from that of any prior survey--26% compared with 17% in 1982 and similar rates in the other two large surveys of 1978 and 1979.[1] For

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[1] Since these surveys were all different regarding sites, age distribution, and truck proportion, caution must be exercised in making direct comparisons.

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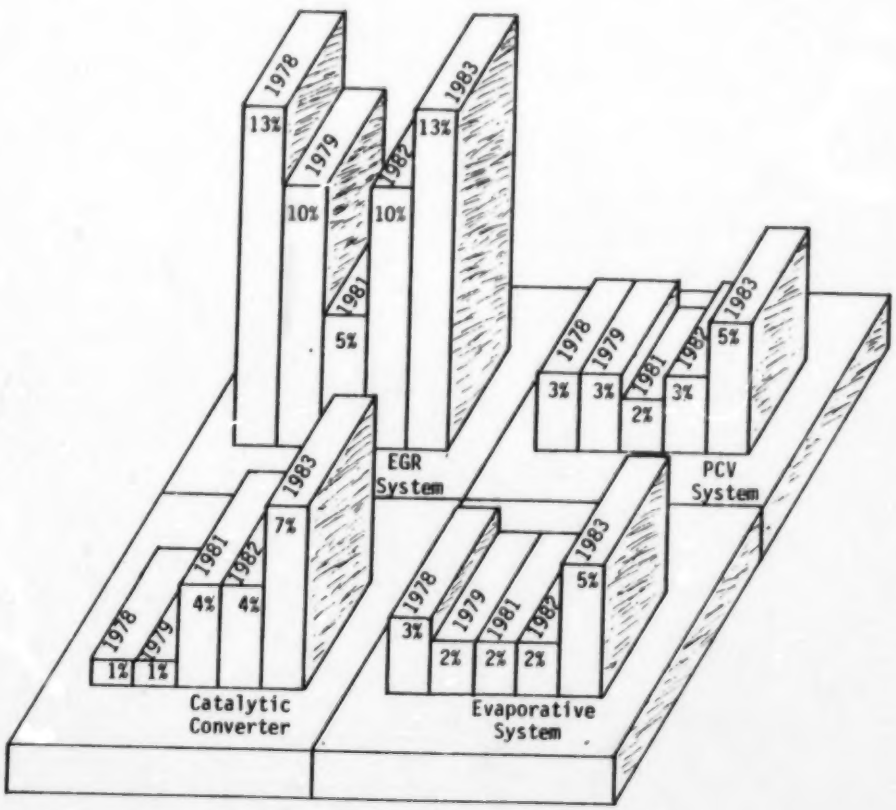
areas with and without I/M programs[1] these overall rates were 24% and 29% respectively. The rate of arguable tampering, 30%, is down from the 38% seen in the 1982 survey, while the malfunctioning rate increased from 1.2% to 3% in this survey.

The component-specific rates for this survey are of considerable interest, since they show significant increases in tampering with certain critical components. Some of this information is presented graphically below.



[1] There were two I/M areas in the survey—Denver, CO, and Phoenix, AZ. Denver, in addition to its conventional idle emissions program, conducts a tampering check on later model vehicles. Because of its different certification standards and unique control program history, Los Angeles is not considered either an I/M area or non-I/M area, but is included in overall rates.

The rate of catalytic converter tampering shows a monotonic pattern of increase over the five surveys, and is sharply up in 1983—a 59% increase to seven percent of the vehicles surveyed. A portion of this increase may be due to the increased age of the vehicles surveyed. Areas without I/M programs had a ten percent rate, while areas with these programs held the rate to a still-substantial five percent. Removal of the catalytic converter brings about an average increase of 475%[1] for HC and 425% for CO. For the three-way converters on more recent models, removal may increase NOx by an average of 300%.

Tampering with PCV[2] and evaporative systems, especially the latter, mirrors the pattern of increase seen for other components. Evaporative tampering more than tripled from the level measured in the 1982 survey, and PCV tampering doubled. The increases in tampering with these HC control systems is particularly puzzling, given the absence of benefits to the vehicle owner associated with their removal or disablement. There was more evaporative system tampering in I/M areas (7%) than in non-I/M areas (4%), but the reverse is true for PCV systems—the rate is slightly higher in non-I/M areas.

EGR[3] system tampering, long the most prevalent form of tampering in these surveys, is exceeded in 1983 only by fuel switching. The rate is up from 1982 by 33% to 13%. The I/M areas sampled had a slightly lower EGR tampering rate than the non-I/M areas—12% as opposed to 15%. The impact of EGR tampering is on NOx emissions, which may increase by an average of 175%.

Air pump system tampering (not shown) increased by over seventy percent

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1 This and other emissions increases mentioned in the report originate in the data for 3-way catalyst vehicles presented in Anti-Tampering and Anti-Misfueling Programs to Reduce In-Use Emissions From Motor Vehicles, EPA-AA-TSS-83-10, December 31, 1983.

2 PCV: Positive crankcase ventilation

3 EGR: Exhaust gas recirculation

to an eight percent level in 1983. The specific I/M areas in the sample actually have a higher rate of air pump system tampering (9%) than non-I/M areas (7%). Air pump disablement affects primarily HC and CO emissions, bringing about increases of 200% and 800% respectively.

Fuel switching

Where fuel switching is defined by the presence of any of three indicators[1], the rate is higher than that of the 1982 survey--a 32% increase to 14%. I/M areas had a fuel switching rate of 12%, while the rate was 17% in non-I/M areas. The pattern of overlap among the three indicators is discussed at some length in the fuel-related tampering section of this report. While the effects of fuel switching vary depending upon its duration and a number of vehicle characteristics, increases of 475% for HC and 325% for CO can easily occur.

Age of vehicle

As has been the case with past surveys, there is a clear relationship between a vehicle's age and the probability that it has been tampered with. This is evident in the graph on the following page which shows the rates by model year for both overall tampering and catalyst removal. Substantial fluctuations in age-specific rates should be expected for very old and very new vehicles because of small sample sizes for those model years. These age-specific rates are considered in longitudinal perspective over the several surveys in the section of this report on tampering and vehicle age.

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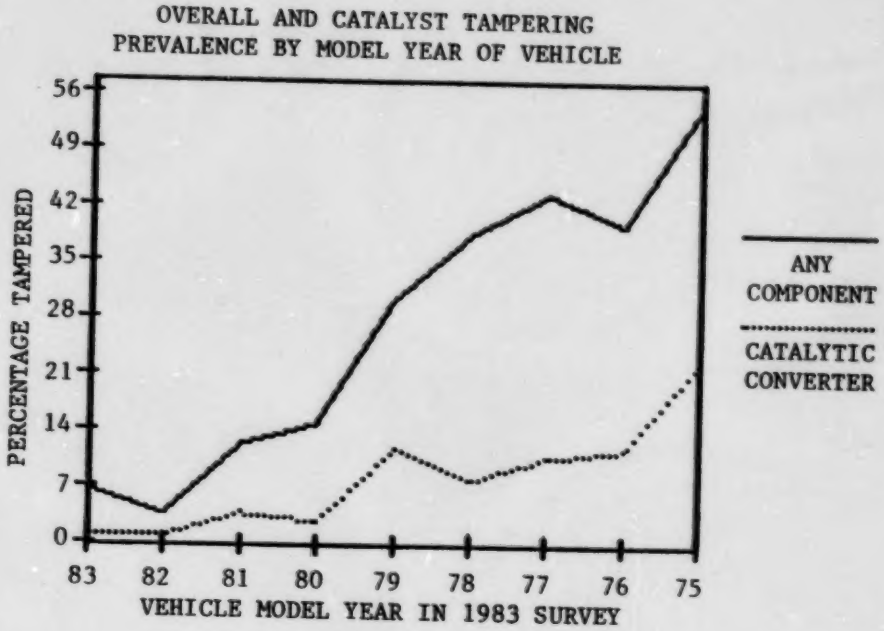
[1] Indicators used are the presence of leaded fuel in the tank, a positive Plumbtesmo test for tailpipe lead deposits, or a tampered filler inlet restrictor. These criteria are used, of course, only with vehicles certified on unleaded fuel.



Truck rates

Rates of all types of tampering tend to be higher for light-duty trucks than for passenger cars as shown below.

Tampering category	Trucks	Cars	Total sample
Overall	30%	24%	26%
Catalytic converter	12	6	7
Air pump system	9	7	7
Evaporative system	7	5	5
PCV	7	5	5
EGR system	16	12	13
Fuel switching	22	12	14

The difference in fuel-related tampering is particularly striking—both catalyst removal and fuel switching are approximately twice as prevalent for light-duty trucks as for passenger cars.

I/M programs and tampering

As indicated above, tampering rates in the survey areas with I/M programs were lower than in areas without programs. The differences, however, were less pronounced than in previous surveys and echo the findings of the 1982 survey in New Jersey. Idle test failure rates of vehicles with different types of tampering are discussed in a later section on this topic. These differences by program status should be interpreted cautiously, since only two I/M sites were included and these differed considerably from each other.

Remainder of the report

The sections of the report that follow primarily develop in greater detail the topics touched upon in this summary. The survey history and methods are explained in more detail, and results are broken out on a site-by-site basis. In addition, certain topics of more specialized interest are discussed.

RESULTS

The detailed results of this year's survey are presented in this section. Topics include the tampering rates for individual sites, trends for sites previously sampled, the various types of tampering, tampering as related to vehicle age, the effect of I/M programs on tampering, fuel-related tampering, truck tampering, and manufacturer-specific tampering.

SITE AND AGGREGATE RESULTS

The vehicles inspected in this survey have been classified into the same four categories established by previous surveys: tampered, arguably tampered, malfunctioning, and okay. Each vehicle is classified according to the most severe state of any one component. Thus a vehicle lacking the catalytic converter with which its configuration was certified is classified as "tampered", regardless of the condition of the other components. If the most severe state of a vehicle is, for example, a missing limiter cap, then that vehicle is classified as "arguably tampered". If a malfunctioning component is the most severe condition of any of the components, then the vehicle is classified as malfunctioning. A vehicle is classified as "okay" only if none of its inspected emission control components exhibit any of the negative conditions discussed above. Criteria for classification of vehicles are presented in Appendix B.

As mentioned in the summary of findings, the overall tampering rates are sharply up from the 1982 survey results—a 53% increase in the percentage with at least one tampered component. More than half of the vehicles surveyed displayed some form of malfunction, arguable tampering, or clear tampering of emission control system components. Figure 1 shows the distribution of survey vehicles among the general categories.

The frequency distribution of tampering instances for those vehicles

FIGURE 1

CONDITION OF SURVEYED VEHICLES

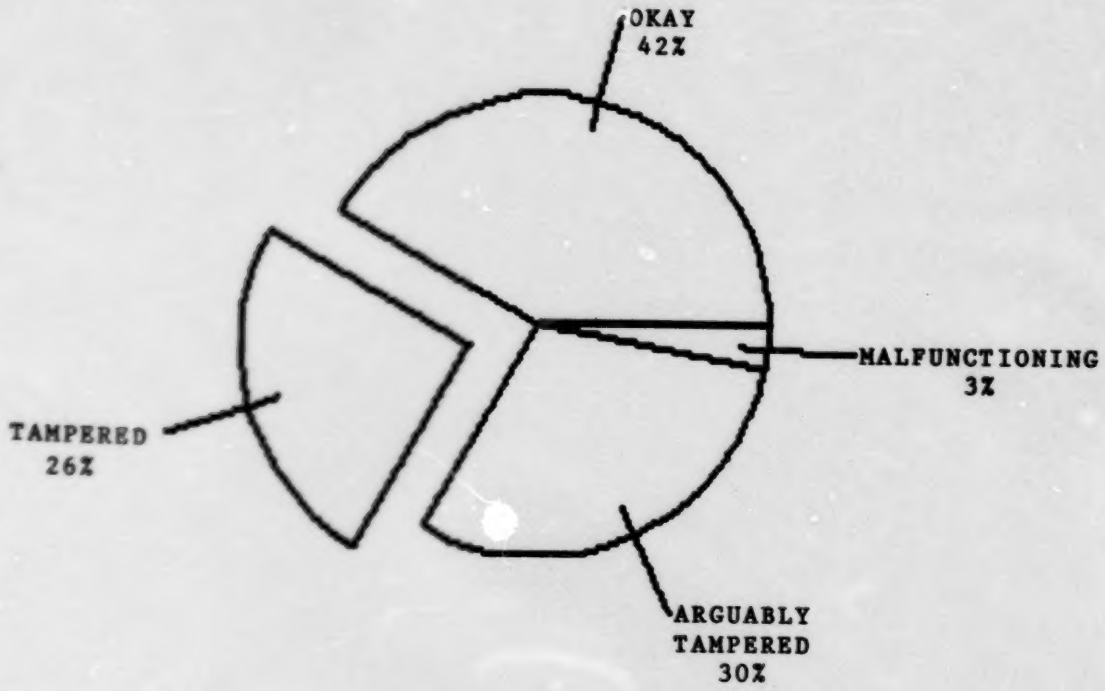
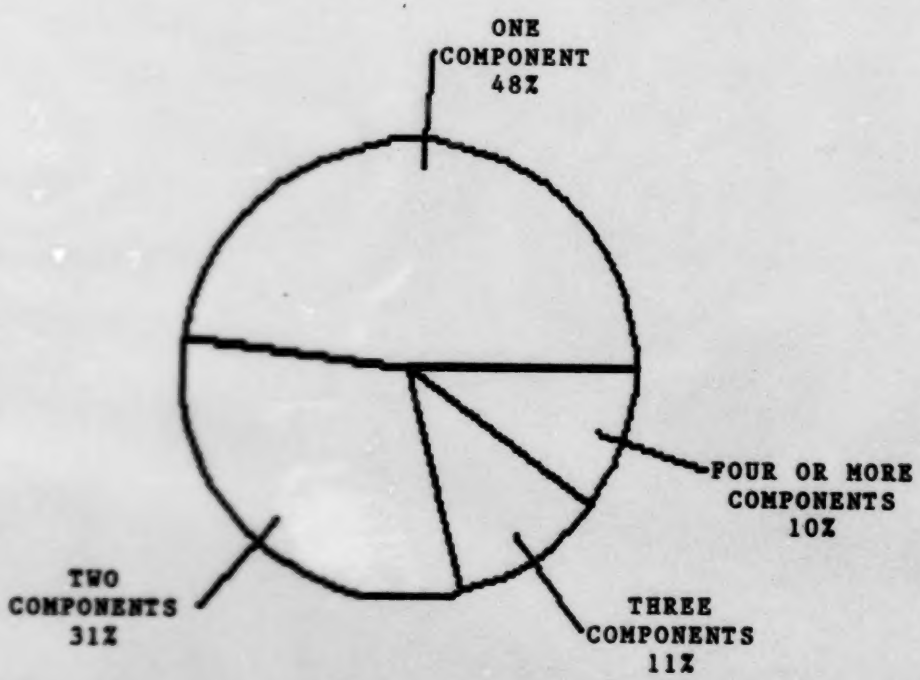


FIGURE 2

EXTENT OF TAMPERING AMONG VEHICLES
WITH AT LEAST ONE TAMPERED COMPONENT



classified as "tampered" is presented in Figure 2. A majority of the tampered vehicles have multiple components tampered, and ten percent of them have four or more instances of tampering.

The vehicle condition classifications are broken out by site below. With the exceptions of Houston at the high end and Los Angeles at the low, the overall tampering rates show relatively little variation from site to site. The high rate in Phoenix is especially interesting in light of the area's long-standing I/M program.

OVERALL VEHICLE CLASSIFICATION BY SITE

Site	Tampered	Arguably tampered	Malfunctioning	Okay
Chicago, IL	27%	42%	2%	29%
Denver, CO	23	24	2	51
Houston, TX	34	24	4	39
Los Angeles, CA	16	26	3	54
Phoenix, AZ	27	39	1	33
Sedgwick Co., KA	24	27	4	46
Entire survey	26	30	3	42

TRENDS - HOUSTON AND PHOENIX

Only two sites included in this year's survey have been covered in prior tampering surveys. Houston has been studied in each survey conducted, and Phoenix was studied earlier in the 1979 survey. The trends for these sites are presented graphically in Figure 3 and Figure 4. A general upward trend for Houston is evident from the chart, with a sharp increase in the rates for this year's survey. The Phoenix rates have obviously increased

FIGURE 3

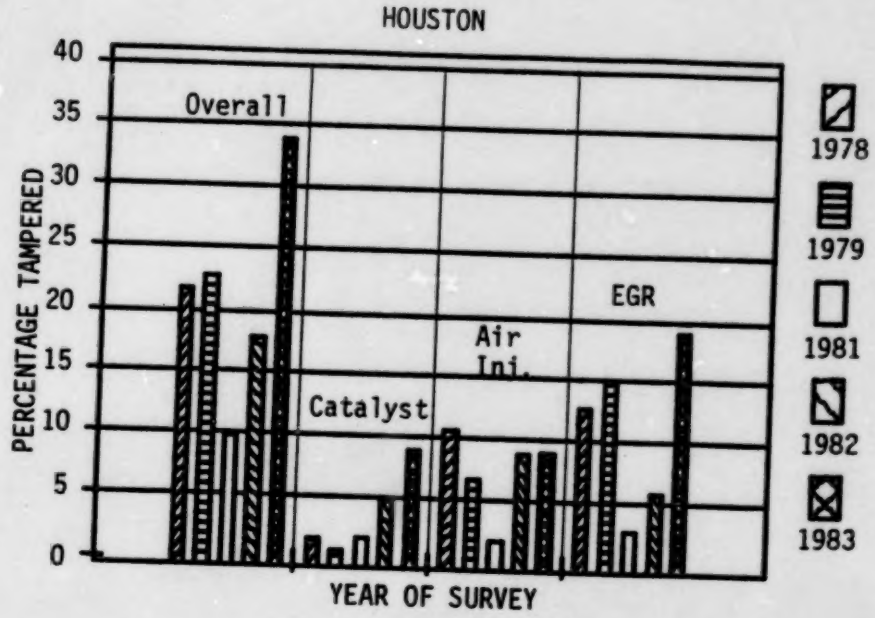
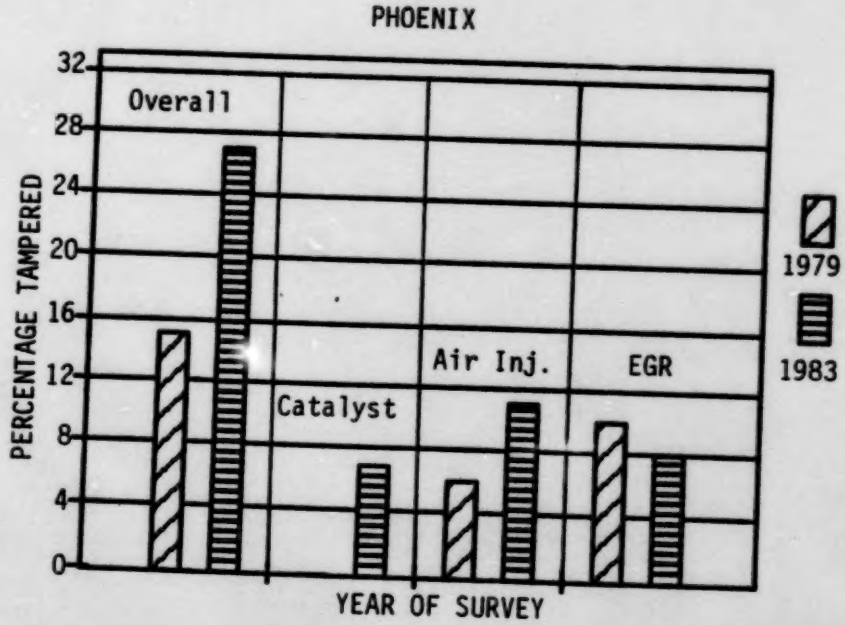


FIGURE 4



markedly from those of the 1979 survey. The two sets of data on Phoenix are quite comparable with regard to vehicle procurement method and refusal rates (inspection lanes and high refusal) but this survey examines an older fleet, and the sample is more heavily weighted with trucks. Recent surveys in Houston prior to this one had very high refusal rates which may partially account for the sharp increases in rates.

TYPES OF TAMPERING

The incidence of tampering with specific emission control components and systems for the various survey years is presented in Table 1. Only those vehicles originally equipped with a particular component are considered when computing the tampering or arguable tampering rate for that component.

While some component-specific trends were discussed in the summary, attention is again directed to the increases in tampering with catalytic converter, PCV system, and evaporative control system. Most of the component-specific rates are higher in 1983 than for previous surveys.

Information on arguable tampering similar to that presented in Table 1 is shown below:

PREVALENCE OF ARGUABLE TAMPERING BY COMPONENT AND SURVEY YEAR

Component	1978	1979	1981	1982	1983
Limiter cap	65%*	62%	83%	54%	54%
Fuel tank cap	0	1	1	2	3
Tank label	5	4	4	4	9
Dash label	1	1	0	1	1
Heated air intake	9	8	9	6	14

* Prevalence percentages in this report have usually been rounded to whole numbers. As a result, some of the retrospective numbers will differ slightly from what was presented in earlier reports.

Table 1

PREVALENCE OF TAMPERING BY COMPONENT AND SURVEY YEAR

Component/System	1978	1979	1981	1982	1983	
EGR* system	13%	10%	5%	10%	13%	
EGR control valve	12	5	5	7	9	
EGR sensor	5	7	5	7	12	
Air pump system	7	5	4	5	7	
Air pump belt	6	4	4	5	7	
Air pump/valve	3	2	4	4	3	
Aspirator**	***	2	0	1	1	
Catalytic converter	1	1	4	4	7	
PCV* system	3	3	2	3	5	
Vacuum spark retard	11	2	1	0	1	
Idle stop solenoid	1	1	0	0	1	
Heated air intake	1	1	0	1	1	****
Evaporative control system	3	2	2	2	5	
Filler neck restrictor	3	4	6	6	7	

* EGR: exhaust gas recirculation
PCV: positive crankcase ventilation

** Vehicles with aspirated air systems are not equipped with other listed air-injection components, nor do conventional systems include aspirators.

*** Aspirators were not checked during the 1978 survey.

**** As indicated in Appendix C, some codes for this component result in the conclusion that tampering has occurred, while others lead to a conclusion of arguable tampering.

Perhaps the most interesting finding among the arguable tampering components is the prevalence of tank label removal, which parallels the increase in fuel switching activity otherwise indicated in this survey.

TAMPERING AND VEHICLE AGE

Table 2 presents information on the relation between vehicle age and the prevalence of tampering for the current survey and previous surveys extending back to 1978. In the same basic format, catalyst tampering information as related to age is shown in Table 3. The most immediately evident conclusion from these tables is that the likelihood of a vehicle's having been tampered with at some point in its life increases with age. In just the 1983 survey data, this conclusion is supported by examining the top diagonal of Table 2 which shows an almost monotonic increase from seven percent tampering among vehicles in their first year to 55% tampering among the few nine-year-old 1975 vehicles sampled in the survey. Table 3 on catalyst tampering shows a similar, though less pronounced, increase on the diagonal from 1% tampered among first-year vehicles to 12% among those in their eighth year (that percentage was almost doubled in the ninth year, but with a small sample size). This approach to reading the table has the distinct advantage of comparing data that were all collected at one time and in one set of locations. Using the diagonal approach, we cannot, however, entirely disentangle the effects of age from effects attributable to model-year-specific differences in performance and tamper-proneness that might lead to different tampering prevalence.

Two alternative ways to read the tables, vertically and horizontally, incur the difficulties of comparing across surveys. The effects of time and geographic location become tied up with the primary interests in changing

Table 2

TAMPERING PREVALENCE AND SAMPLE SIZE BY MODEL YEAR AND VEHICLE AGE AT TIME OF SURVEY

Model Year	Year of Vehicle Life								
	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Ninth
1983	7%(182)								
1982	1(25)	4%(226)							
1981	2(57)	7(448)	13%(206)						
1980		5(63)	9(454)	15%(211)					
1979	6(371)		9(59)	18(477)	31%(288)				
1978	7(298)	14(502)		15(79)	21(430)	39%(238)			
1977		10(457)	15(476)		21(66)	26(316)	44%(190)		
1976			18(395)	19(374)		29(52)	26(317)	40%(171)	
1975				22(274)	22(271)		32(33)	37(183)	55%(89)
1974					33(276)	27(242)			
1973						32(253)	36(251)		

Table 3

PREVALENCE OF CATALYST REMOVAL AND SAMPLE SIZE BY MODEL YEAR AND VEHICLE AGE AT TIME OF SURVEY

Model Year	Year of Vehicle Life								
	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Ninth
1983	1%(179)								
1982	0(250)*	1%(225)							
1981	0 (57)	2(441)	5%(204)						
1980		2 (61)	2(428)	3%(200)					
1979	0(326)		4 (55)	6(429)	12%(252)				
1978	0(291)	0(445)		0 (71)	4(362)	8%(213)			
1977		1(417)	1(417)		2 (59)	2(271)	11%(166)		
1976			2(377)	2(305)		10(48)	6(257)	12%(139)	
1975				2(242)	2(204)		26(19)	12(139)	23%(75)

* Tampering rates have been rounded to the nearest whole percent. A zero does not necessarily indicate the total absence of tampering, but rather a level of tampering that rounded to zero.

technology (for vertical comparisons) and vehicle age (for horizontal comparisons).

Using the horizontal approach to Table 2 we see a definite and monotonic increase with age throughout the table for all model years except the pre-catalyst 1974 models. The 1978 model year, for example, displayed a seven percent tampering rate when it was first examined in the 1978 survey. The current survey indicates that 39% of the vehicles of the same model year (approximately six years old at the time of the 1983 survey) display some form of tampering. As mentioned above, this conclusion involves comparing observations made at different groupings of sites and at different times, but the conclusion that tampering prevalence increases with age is nonetheless a firm one.

Vertical comparisons of different model years (and thus, generally, across technologies) hold the age of the vehicle constant. For example, thirteen percent of the three-year-old 1981 vehicles seen in the current survey had some tampering. This is compared with data from the 1978 survey on 1976 vehicles which were about three years old and had an 18% tampering prevalence. Such vertical comparisons in these tables clearly reflect both any differences attributable to changing technology and changes in general tampering behavior over time. The differing site composition of the surveys is an obvious confounding factor when the tables are read vertically. The table on overall tampering shows no clearly discernible pattern—no sharp decrease in overall tampering attributable to the introduction of closed-loop emission control systems in 1981. This conclusion is reinforced by a similar vertical reading of Table 3 on catalyst tampering. The table certainly does not support the proposition of a prophylactic effect of the post-1980 technology.

EFFECTS OF INSPECTION AND MAINTENANCE ON TAMPERING

Inspection and maintenance (I/M) areas require vehicles to meet specific idle emission standards. Vehicles registered in these areas are required to be periodically tested to assure that they comply with the specific idle emission cut-points established by these jurisdictions. In addition to reducing emission levels by stimulating better owner maintenance, these I/M programs have generally been perceived to deter tampering with emission control components. Data from previous surveys have tended to support this perception, since I/M area tampering rates have indeed been lower than non-I/M rates.

The 1983 motor vehicle tampering survey has incorporated two I/M sites (Denver and Phoenix) and three Non-I/M sites (Chicago; Sedgwick County, Kansas; and Houston). Los Angeles, CA. was the sixth site to be inspected, but cannot be legitimately classified as either an I/M or a non-I/M site and is thus excluded from this particular analysis.

Tampering rate differences. A comparison was made of the overall tampering levels in I/M and non-I/M sites. This rate is 29% for the non-I/M areas and 24% for the I/M areas. The difference for cars only is more pronounced--29% in non-I/M areas compared with 22% in I/M areas. Table 4 presents the component or system-specific rates for I/M and non-I/M areas differentiated by vehicle type.

These rates are significantly lower in the I/M areas for some major components. In particular, catalytic converter tampering for cars in I/M areas is 3% as compared with the 10% non-I/M rate for cars. Likewise, the rate of tampering with cars' EGR systems in the I/M areas is 10%, but 15% in the non-I/M areas. Evaporative system rates for cars reverse this

Table 4

TAMPERING/FUEL SWITCHING PREVALENCE IN I/M AND NON-I/M AREAS BY VEHICLE TYPE

Tampering Category	I/M areas		Non-I/M areas		Phoenix		Denver	
	cars	trucks	cars	trucks	cars	trucks	cars	trucks
At least one component tampered	22%	36%	29%	28%	23%	44%	21%	30%
Catalytic converter	3	16	10	12	3	25	3	8
Air pump system	7	15	7	9	8	23	6	9
Evaporative * control system	6	9	4	6	5	12	7	7
PCV system *	5	4	5	10	8	4	2	5
EGR system *	10	21	15	15	5	19	15	23
Fuel Switched	9	25	15	23	9	39	9	13

* Since these systems do not control tailpipe emissions of pollutants covered in I/M programs, it can be logically argued that I/M areas should not differ from other areas with regard to the rates of tampering with these systems.

pattern, with higher rates in the areas covered by I/M programs.

The truck rates reverse the pattern of differences seen for cars, with I/M areas having higher rates on all of the tabled components except the PCV system. These higher I/M truck rates, except for PCV and EGR systems, are attributable mostly to the rates for the Phoenix trucks which, as Table 4 indicates, are strikingly high. Differences in age distribution between the Phoenix sample and the rest of the survey can partially account for the higher Phoenix truck rates. The presence of only two I/M sites in the survey and the somewhat unusual nature of the Phoenix data point to a need for caution in drawing any conclusions regarding differences attributable to I/M programs.

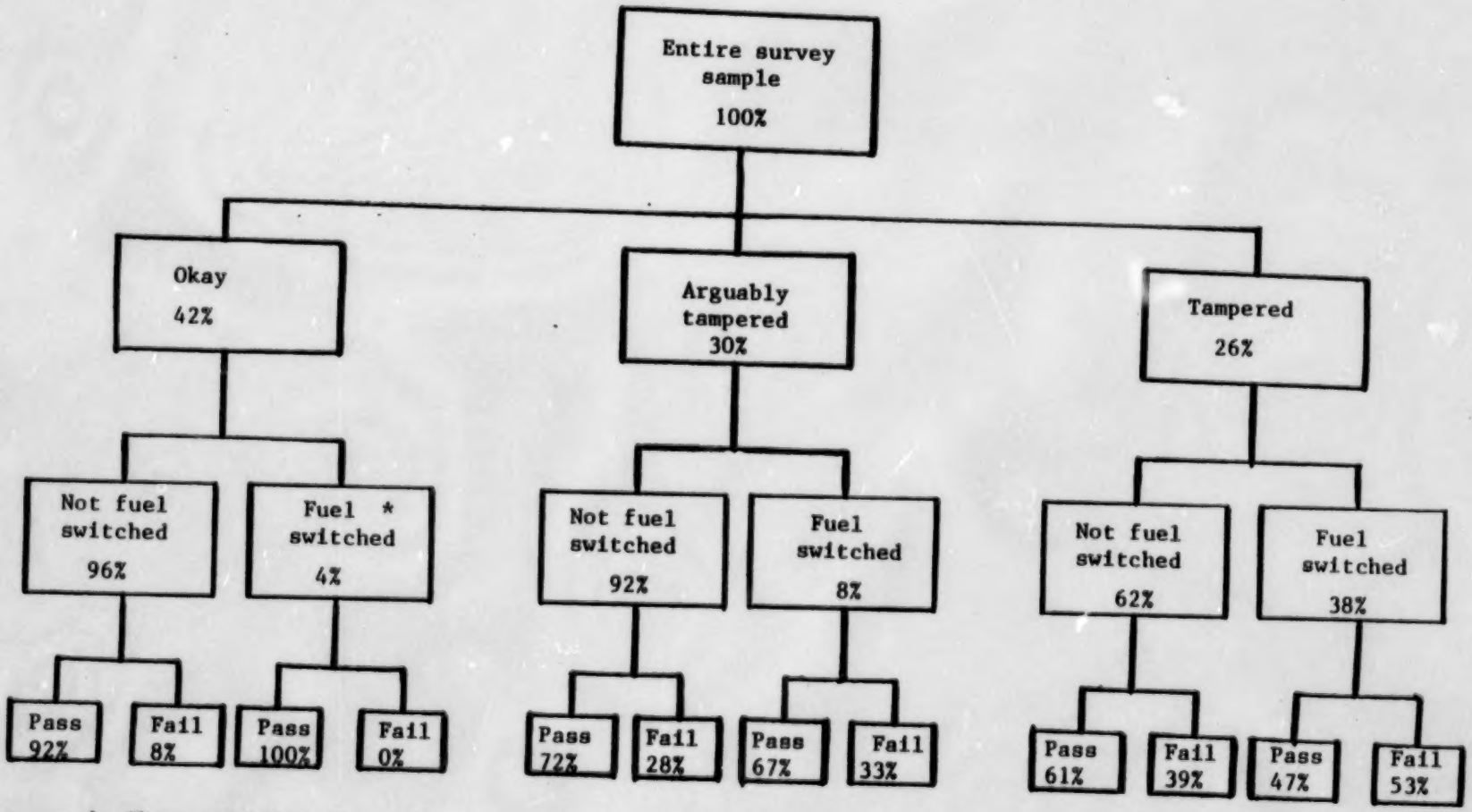
EFFECTS OF TAMPERING ON IDLE TEST FAILURE RATES

As mentioned in the previous section, vehicles which are subject to an I/M program must meet specific idle emission cutpoints. To assess the effects tampering and fuel switching may have on idle failure rates, idle emissions of vehicles have been tested against the cutpoints established by the I/M programs where they were sampled. Vehicles in the non-I/M sites were tested against the cutpoints specified by the New Jersey I/M program.

The results of the idle tests performed on survey vehicles are presented in Figure 5 for vehicles in the various tampering and fuel switching categories. Only eight percent of the survey vehicles free of tampering and fuel switching failed an idle test, while slightly more than half of the tampered and fuel switched vehicles failed that test. Certainly these results indicate that a substantially larger proportion of tampered and fuel switched vehicles than intact vehicles fail an idle test at typical I/M

FIGURE 5

DISTRIBUTION OF SURVEY SAMPLE AMONG TAMPERING, FUEL SWITCHING, AND IDLE TEST CATEGORIES



* These vehicles do not have any mechanical tampering, but may be fuel switched as indicated by lead in their fuel tanks or a positive tailpipe test for lead.

cutpoints. It must be noted, though, that almost half of these vehicles with compromised emission control systems passed the idle test. Failure rates on specific pollutants are presented below.

IDLE TEST FAILURE RATES BY POLLUTANT AND VEHICLE CONDITION

HC				CO			
Okay	Tampered	Arguably tampered	Cat./Fuel*	Okay	Tampered	Arguably Tampered	Cat./Fuel*
3%	26%	17%	30%	6%	19%	11%	14%

* Vehicles in this category either have their catalyst removed or have at least one of the three indicators of fuel switching.

In general I/M sites continue to maintain lower idle test failure rates than non-I/M sites--17% for I/M compared with 32% for non-I/M. The overall survey rate was 24%. The two I/M areas included differed considerably in their failure rates-the rate for Phoenix was 20%, as compared with Denver's 14% rate.

The table on the following page presents the mean idle emission levels for tampered and intact vehicles by type of area. The idle test mean for tampered vehicles is sharply higher than that for intact ones. Also the means for non-I/M areas are higher than for I/M areas. The effect of the I/M programs, independent of differences in tampering rates, may be seen in an examination of the "okay" levels, where the non-I/M HC level is more than double that for the I/M areas. The difference is similar for CO--0.7% for non-I/M versus 0.4% for I/M.

MEAN IDLE EMISSIONS

	HC(ppm)		CO(%)	
Area	Tampered	Okay	Tampered	Okay
Entire survey	297.0	51.5	2.5	0.5
I/M areas	187.3	36.1	1.8	0.4
Non-I/M areas	378.7	75.8	2.9	0.7

FUEL-RELATED TAMPERING

Multiple indicators. While a simple definition of fuel switching is possible, a single indicator for detection of this activity is very likely to underestimate its prevalence. For instance, a vehicle which was repeatedly improperly fueled with leaded gasoline during a gasoline shortage may have a deactivated catalytic converter, but due to proper subsequent fuel use may have little detectable lead in its fuel tank. This situation may also characterize the "occasional" user of leaded fuel.

In order to obtain a better picture of fuel switching, this survey includes three indicators which, singly and in combination, may provide more adequate information than any one measure by itself. The indicators include fuel filler inlet restrictor tampering, a positive Plumbtesmo test for lead deposits in the tailpipe, and the presence of more than 0.05 gram per gallon of lead in the gasoline. While the presence of lead in the fuel provides a very strong indication of switching, its absence does not indicate that switching has not occurred in the past. Likewise, but for different reasons, the other two measures individually also present the problem of incorrect negative findings where switching has actually occurred. A vehicle with an untampered fuel filler inlet restrictor may have been fueled at a leaded

pump with a small sized nozzle or with a funnel or similar device. The tailpipe lead test, due to the difficulties of field administration, may fail to indicate the presence of lead, and older vehicles may have had their tailpipes replaced since they were operated on leaded fuel. The error in these measures, then, is always in the direction of underestimating the proportion of catalysts exposed to leaded fuel.

Fuel switching rates. Of the vehicles requiring unleaded fuel, 14% were identified as fuel switched by at least one of the indicators discussed above. Table 5 displays the rates found for individual indicators as well as the composite rates for I/M and non-I/M areas.

While fuel switching rates have increased somewhat from those of the 1982 survey, both in general and for the individual indicators, the most striking information in the table is the rates for I/M areas. While the 1982 survey examined different sites and comparisons are thus difficult, each of these 1983 rates is approximately double the corresponding 1982 rates.

Indicator overlap. The survey results seem to show less overlap than one might expect among these three indicators of the same phenomenon. The Venn diagram below illustrates this. The incomplete overlap tends to lend credence to the position that these measures reflect different aspects of fuel switching activity.

Since incorrect positive indications are extremely rare for these measures, the percentage of vehicles with at least one positive indicator seems most reasonable as a minimum estimate of the fuel switching rate in these cities. Reasons for the real rate possibly being higher include the negative bias of the field-administered plumbtesmo tailpipe test and the bias always associated with refusal to participate in a non-compulsory survey.
The latter bias has been kept relatively low in this survey since all but

Table 5

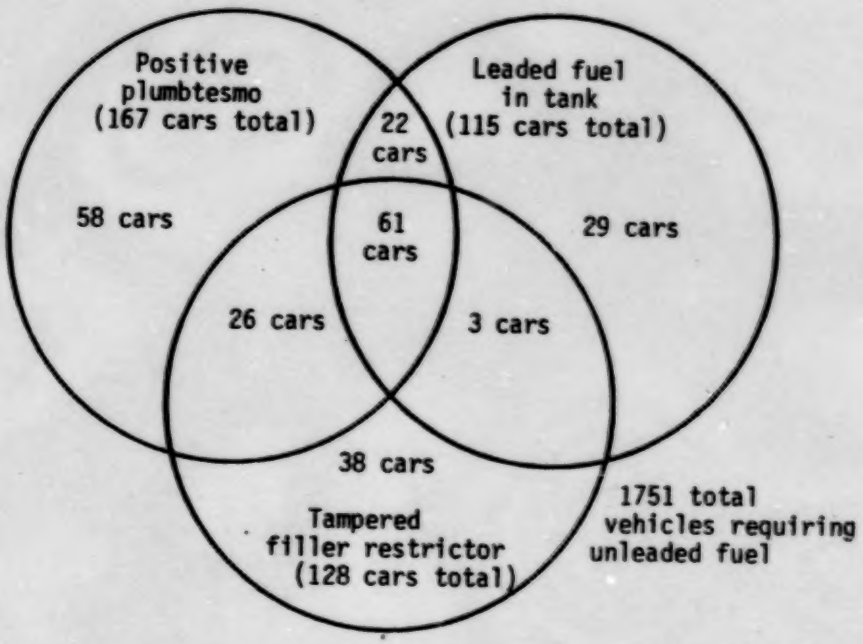
FUEL SWITCHING RATES FOR CURRENT SURVEY BY SITE AND INDICATOR

Site	Percent with at least one positive indicator	Percent with leaded fuel in tank	Percent with tampered filler restrictor	Percent with positive tailpipe test
		Non-I/M sites		
Chicago	18%	9%	9%	13%
Sedgwick Co., KA	13	7	6	10
Houston	19	8	9	13
All non-I/M	17	8	8	12
		I/M sites		
Denver	10	5	4	6
Phoenix	15	7	12	12
All I/M	12	6	8	9
Los Angeles*	5	2	3	3
All sites	14	7	7	10

* Los Angeles is considered to be neither I/M nor non-I/M.

one of the sites involved roadside pullovers with their associated lower refusal rates.

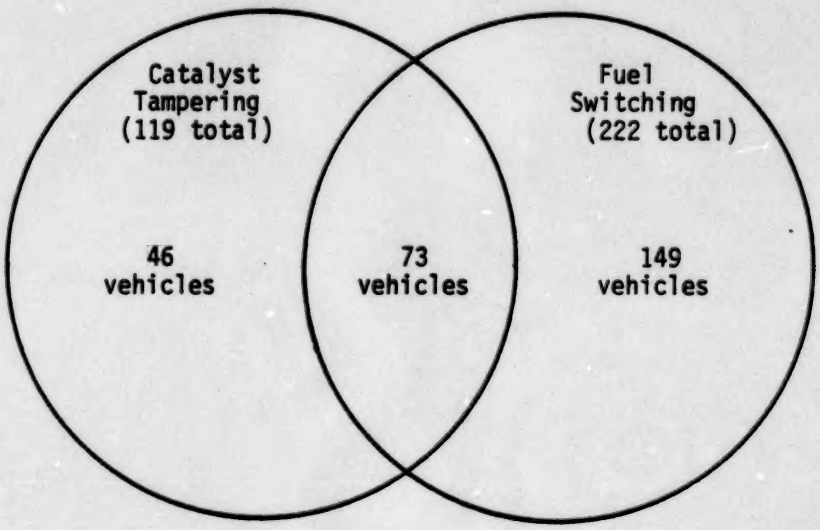
OVERLAP OF
FUEL SWITCHING INDICATORS



Catalyst tampering and fuel switching. While there may be a variety of reasons why consumers and mechanics remove catalytic converters, some of this motivation is obviously tied up with fuel switching. The data from this survey provide little basis for inference regarding direction of causation or the temporal ordering of these events in the vehicle's life, but it is possible from the survey to at least examine the extent to which these types of abuse occur in conjunction. Of the catalyst-equipped vehicles in the survey sample 16% were either catalyst-tampered or fuel switched. Thirteen percent of the vehicles in the I/M areas surveyed, and 21% of the catalyst

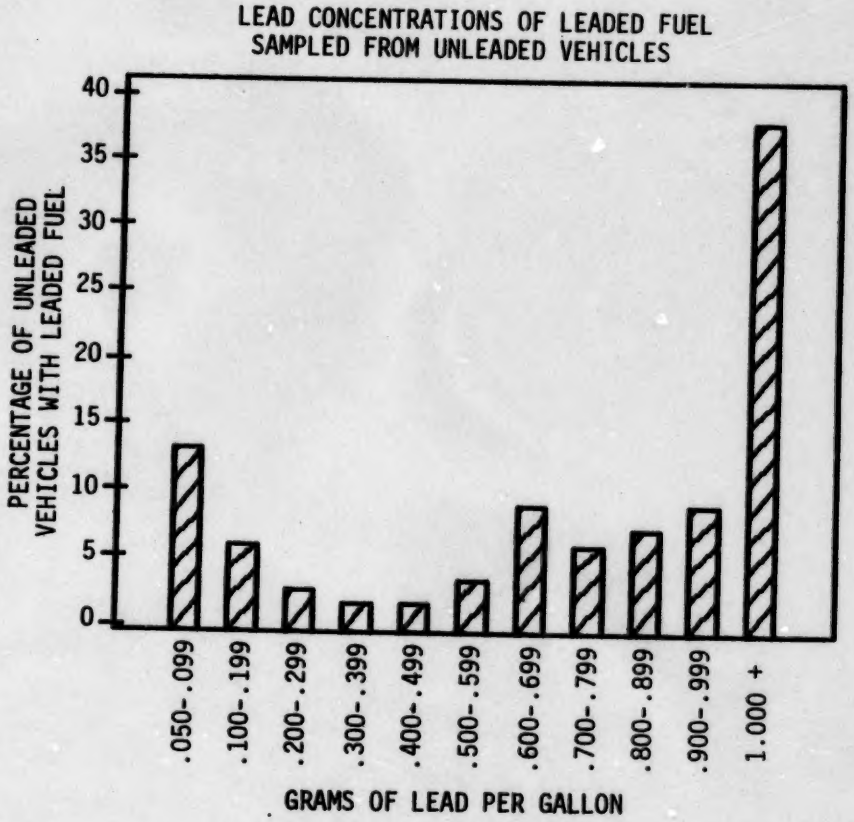
vehicles in non-I/M areas had one or both of these conditions. The overlap between the conditions can be seen in the illustration below.

OVERLAP OF CATALYST TAMPERING
AND FUEL SWITCHING



Vehicles with catalyst tampering exclusive of fuel switching were relatively uncommon in this sample--more than 60% of the catalyst tampered vehicles also were fuel switched. On the other hand, fuel switching is by no means always accompanied by catalyst removal. Sixty-seven percent of the fuel switched vehicles still had their catalysts.

Gasoline lead concentrations. About half of the vehicles indicated to be fuel switched by one of the three indicators had only trace amounts (less than .02 gram per gallon) of lead in their fuel when inspected. These vehicles, then, were identified as fuel switched by a tampered filler restrictor and/or a positive plumbtesmo test for prior lead use. The chart on the following page presents the lead concentrations in the fuel of sampled vehicles with more than 0.05 gram per gallon in their gasoline.

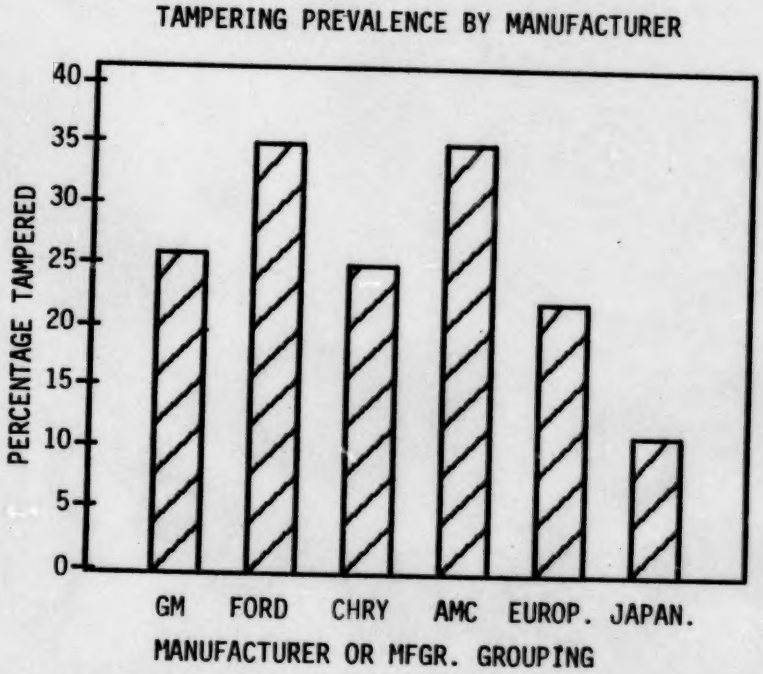


Truck rates

As indicated previously, the prevalence of tampering for light duty trucks is higher than that for passenger cars. The table on page 7 shows the substantial differences in the rates. Each emission component for the light duty trucks tends to have a higher prevalence of tampering than do the cars. Catalyst and filler inlet restrictor tampering among trucks is double the amount for cars. Fuel switching also tends to be considerably higher for trucks--22% compared with 12% for cars.

Manufacturer-specific rates

As in most previous surveys, tampering prevalence in this survey is higher for domestic than for foreign manufacturers, with vehicles of Japanese manufacturers having the lowest rates. Among domestic makers, AMC and Ford have the highest prevalence at 35%, followed by GM and Chrysler at 26% and 25% respectively. These rates are shown in the graph below.



Manufacturer differences in overall tampering may be due to a variety of factors including but not limited to manufacturer-specific tamper-proneness. Market share history gives rise to differences in age distribution among

vehicles of different makes, and age is clearly related to tampering prevalence. Additionally, certain types of vehicles (trucks, for instance) are more likely to be subjected to tampering than others, and thus makers with production concentrated in these types can be expected to experience higher rates.

APPENDIX A

RELEVANT PORTIONS OF THE CLEAN AIR ACT

Section 203(a)(3): The following acts and the causing thereof are prohibited --

(A) for any person to remove or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine in compliance with regulations under this title prior to its sale and delivery to the ultimate purchaser, or for any manufacturer or dealer knowingly to remove or render inoperative any such device or element of design after such sale and delivery to the ultimate purchaser; or

(B) for any person engaged in the business of repairing, servicing, selling, leasing, or trading motor vehicles or motor vehicle engines, or who operates a fleet of motor vehicles, knowingly to remove or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine in compliance with regulations under this title following its sale and delivery to the ultimate purchaser.

APPENDIX B

INSPECTION AND DATA RECORDING PROCEDURES

The inspection teams consisted of five inspectors. A designated team leader was responsible for data and sample collection. Each vehicle inspection included checking all emission control systems, recording basic data about the vehicle including the addition of certain after-market parts, measuring HC and CO emissions at idle, obtaining a fuel sample, and using Plumbtesmo paper to check for lead deposits in the vehicle tailpipes. The inspections focused on 1975 and newer light-duty vehicles fueled with gasoline. This included both passenger cars and light-duty trucks. The condition of each emission control device was determined and recorded on the inspection forms in the field. Categorization of the results was not made at the time of the inspection--rather this was determined by evaluating the recorded data subsequent to the surveys.

Below is a listing of the sites, the inspection dates, the number of vehicles inspected, the procedures used to obtain vehicles for inspection, and the refusal rates.

Cook County, Illinois

Method of vehicle procurement:	Roadside pullover
Dates of inspections:	Sept. 12 - Sept. 15, 1983
Number of vehicles inspected:	268
Refusal rate:	1%

Sedgwick County, Kansas

Method of vehicle procurement:	Roadside pullover
Dates of inspections:	Sept. 19 - Sept. 23, 1983
Number of vehicles inspected:	290
Refusal rate:	9%

Houston, Texas

Method of vehicle procurement:	Roadside pullover
Dates of inspections:	Sept. 26 - Oct. 1, 1983
Number of vehicles inspected:	374
Refusal rate:	8%

Denver, Colorado

Method of vehicle procurement:	Roadside pullover
Dates of inspections:	Oct. 3 - Oct. 7, 1983
Number of vehicles inspected:	332
Refusal rate:	3%

Los Angeles, California

Method of vehicle procurement:	Roadside pullover
Dates of inspections:	Nov. 28 - Dec. 2, 1983
Number of vehicles inspected:	270
Refusal rate:	4%

Phoenix, Arizona

Method of vehicle procurement:	I/M inspection station
Dates of inspections:	Dec. 5 - Dec. 9, 1983
Number of vehicles inspected:	297
Refusal rate:	26%

DATA RECORDING FORMS

The forms on the following two pages were used for recording the survey data in the field. The forms are of the forced choice variety to assure consistency in coding. They are designed to facilitate direct data entry.

TAMPERING SURVEY - PART A

Column #

1 ID Number / / / / /

5 Odometer (Thou.) / / / /

8 Dash Label
0 - Not orig. equipped
1 - Functioning properly
7 - Missing item

9 Make / / / / /

13 Model / / / / /

17 Model Year / / /

19 Vehicle Type
1 - Car
2 - Truck(includes vans)

20 License Plate(State) / / /

22 Displacement / / / / /
(cubic inches or liters)

** NOTE: If engine fam. is missing or illegible write "missing" in item 26 and copy all but the last 6 digits of the VIN in item 37. DO NOT COPY SERIAL NUMBER PORTION OF VIN.

26 Engine Family
/ / / / / / / / / / / /

37 VIN (if engine fam. info not avail.)
/ / / / / / / / / / / / / / /

50 Originally Catalyst Equipped
(from sticker under hood or driver's door post)
1 - Yes
2 - No
3 - Can't tell (no sticker or not readable)

51 Idle HC / / / / / (in PPM)

Column #

55 Idle CO / / / / / (in %)
(to 1/10 percent)

59 Plumbtesmo
P - Positive
N - Negative

60 Tank Cap
1 - Functioning properly
7 - Missing Item
9 - Malfunctioning

61 Tank Label
0 - Not orig. equipped
1 - Functioning properly
7 - Missing item

62 Filler Neck Restrictor
0 - Not orig. equipped
1 - Functioning properly
4 - Mech. disc. (widened)
7 - Missing item

63 Catalytic Converter
0 - Not orig. equipped
1 - Functioning properly
7 - Missing item
9 - Malfunctioning

64 Exhaust System
P - Original equipment
N - Non-stock

65 Exhaust System Integrity
1 - Functioning properly
(no obvious leaks)
9 - Malfunctioning
(leaks evident)

66 Oxygen Sensor
0 - Not orig. equipped
1 - Functioning properly
2 - Electrical disconnect
4 - Mech. disc. (unscrewed)
7 - Missing item

Inspector's Initials _____

Date / / / / / / / /
Day Mon. Yr.

TAMPERING SURVEY - PART B

Col. #

1 ID number / / / / /

5 Air Cleaner
- P - Orig. equip.
- 6 - Non-stock

6 Exhaust Manifold
- P - Orig. equip.
- 6 - Non-stock

7 Intake Manifold
- P - Orig. equip
- 6 - Non-stock

8 Distributor
- P - Orig. equip.
- 6 - Non-stock

9 Turbocharger
- 0 - Not orig. equipped
- P - Original equipment
- 6 - Non-stock
- A - Add-on

10 Carburetor Type
- P - Orig. equip. (non sealed.)
- S - Sealed carb.
- F - Fuel injection used
- 6 - Non-stock carb

11 Carburetor barrels
- 0 - Not orig. equipped
- 1
- 2
- 4

12 Limiter Caps
- 0 - Not orig. equipped (fuel injection)
- 1 - Funct. properly
- 4 - Mech. disconnect (tabs broken or bent)
- 7 - Missing item
- 8 - Misadjusted (sealed plugs removed)

Col. #

13 PCV system
- 0 - Not orig. equipped
- 1 - Funct. properly
- 3 - Vacuum disconnect
- 4 - Mech. disconnnect (fresh air hose)
- 6 - Non-stock (Incl. fuel economy devices)
- 7 - Missing item

14 Idle Stop Solenoid
- 0 - Not orig. equipped
- 1 - Funct. properly
- 2 - Elect. disconnect
- 7 - Missing item
- 9 - Malfunctioning

15 Heated Air Intake
- 0 - Not orig. equipped
- 1 - Funct. properly
- 3 - Vacuum disconnect
- 4 - Mech. disconnect
- 6 - Non-stock (custom air cleaner)
- 7 - Missing item (stovepipe hose)
- 9 - Malfunct. item (Vac. override)

16 Evap. Control System
- 0 - Not orig. equipped
- 1 - Funct. properly
- 3 - Vacuum discon. (Carb. line)
- 4 - Mech. discon. (tank line)
- 5 - Incorr. routed hose
- 7 - Missing item
- 9 - Malfunct. item (air cleaner unsealed)

17 Aspirated Air Injection System
- 0 - Not orig. equipped (if conventional system or none)
- 1 - Funct. properly
- 4 - Mech. disconnect
- 7 - Missing item
- 9 - Malfunctioning

Col. #

18 Air Pump Belt (if Aspir., code "0")
- 0 - Not orig. equipped
- 1 - Funct. properly
- 7 - Missing item
- 8 - Misadjusted item (loose)

19 Air Pump System(incl valve)
- 0 - Not orig. equipped(if aspirated or none)
- 1 - Funct. properly
- 4 - Mech. disc. (other than belt removal)
- 7 - Missing item
- 9 - Malfunctioning

20 EGR Control Valve
- 0 - Not orig. equipped
- 1 - Funct. properly
- 3 - Vacuum disconnect
- 7 - Missing item
- 9 - Malfunct. item

21 EGR Sensor
- 0 - Not orig. equipped
- 1 - Funct. properly
- 3 - Vacuum disconnect
- 5 - Incorrect hose routing
- 7 - Missing item
- 9 - Malfunct. item

22 Vacuum Spark Retard
- 0 - Not orig. equipped
- 1 - Funct. properly
- 2 - Elect. disconnect
- 3 - Vacuum disconnect

Inspector's initials _____

Date / / // / // / / (Mon. Day Yr.)

The following codes were used to record data for the major system components on the data sheets shown on pages B - 1 & B - 2.

0 - Not originally equipped

1 - Functioning properly

2 - Electrical disconnect

3 - Vacuum disconnect

4 - Mechanical disconnect

5 - Incorrect routed hose

6 - Non-stock

7 - Missing item

8 - Misadjusted item

9 - Malfunctioning

Additional codes were used for those components which could not be classified into the above categories.

a). ID Number - Vehicles are numbered sequentially as they are inspected. This number is preceded by a site identifying letter.

b). Odometer - mileage in thousands

c). Dash label - displays the required fuel and will be coded '0', '1' or '7'.

d). Make

e). Model

f). Model year - supplied by underhood emission label.

g). Vehicle type - coded as follows:

1 - car
2 - truck

h). License plate (State)

i). Displacement - as recorded by the underhood emission label.

j). Engine family - as recorded by the underhood emission label.

k). Non-serial number portion of VIN - as recorded from the passenger side of dash under windshield or driver's door post. Recorded only if engine family cannot be determined.

l). Originally catalyst equipped - as recorded by the underhood emission label or driver's door panel.

m). Idle HC in ppm and CO in percent with the engine at curb idle.

n). Plumbtesmo - Plumbtesmo paper is used to check for the presence of lead in vehicle exhaust pipes. A positive indication is coded as 'P' and a negative as 'n'.

o). Tank cap - seals the fuel tank during normal operating conditions and will be coded '1', '7' or '9'.

p). Tank label - displays required fuel and will be coded '0', '1' or '7'.

q). Filler neck inlet restrictor (unleaded vehicles only). The restrictor is designed to prevent the introduction of leaded fuel into a vehicle requiring unleaded fuel. It will be coded '0', '1', '4'(widened) or '7'.

r). Catalytic converter - oxidizes the HC and CO to water and CO2 in the exhaust

gases. Later model catalysts also convert oxides of nitrogen. The converter will be coded '0', '1', '7' (catalyst removed from cannister or entire cannister removed), or '9' (high temperature discoloration, usually light blue.

s). Exhaust system - if originally equipped a 'P' is coded. If non-stock an 'N' is coded.

t). Exhaust system integrity - the condition of the exhaust system is coded as follows: '1' (no obvious leaks) and '9' (leaks evident).

u). Oxygen sensor - controls the air-fuel mixture going into the engine. Primary purpose is to work with 3-way catalytic converters. The oxygen sensor will be coded '0', '1', '2', '3' (unscrewed) and '7'.

v). Inspector's initials - quality assurance measure.

w). Date

x). ID number - same as (a).

The codes below are used to record data for components y through D.

0 - Not originally equipped

P - Original equipment

6 - Aftermarket or non-stock

A - Add-on equipment

S - Sealed carburetor

F - Fuel injection used

y). Air cleaner, exhaust manifold, intake manifold and distributor - will be coded 'P' or '6'.

z). Turbocharger - will be coded '0', 'P', '6' or 'A'.

A). Carburetor type - will be coded 'P', 'F', '6' or 'S'.

B). Carburetor barrels - is coded '0' or the actual number of barrels (1,2, 3 or 4).

C). Limiter caps - plastic caps on idle mixture screws designed to limit carburetor adjustments. The limiter cap is coded '0', '1', '4' (tabs broken or bent), '7' or '8' (sealed plugs removed).

D). Positive crankcase ventilation system—prevents crankcase emissions by purging the crankcase of blow-by gases which leak between the piston rings and the cylinder wall in the combustion chamber when high pressures are developed during the compression and power strokes. The PCV system is coded '0', '1', '3', '4' (fresh air hose), '6' (includes fuel economy devices) or '7'.

E). Idle stop solenoid - provides an idle stop for maintaining idle speeds at higher rpm levels and prevents the throttle plate from fully closing during deceleration in order to minimize CO emissions. The idle stop solenoid will be coded '0', '1', '2', '7' or '9'.

F). Heated air intake - provides warm air to the carburetor during cold engine operation. The heated air intake will be coded '0', '1', '3', '4', '6' (custom air cleaner), '7' (stovepipe hose), '9' (Vacuum override).

G). Evaporative control system - controls vapors from the fuel tank and carburetor. Some systems have two lines, one from the fuel tank to the canister, and one from the canister to the carburetor or air cleaner to air purge the canister.

Other systems have a third line, usually connected to the carburetor. The ECS is coded '0', '1', '3' (carburetor line), '4' (tank line), '5', '7' or '9' (air cleaner unsealed).

H). The Air Injection System keeps the exhaust emission levels within the specified limits and still maintains proper vehicle performance characteristics by extending the combustion process into the engine's exhaust system through the injection of fresh air into the exhaust ports. The air injection system consists of an air pump driven by a belt connected to the crankshaft pulley. The pump directs air through a control valve and lines connected to the exhaust manifold. An air injection system may also consist of an aspirator located in the air cleaner that supplies air to the exhaust manifold.

a). aspirated air injection system - is coded '0' (if conventional system or none), '1', '4', '7' or '9'.

b). air pump belt (if Aspirated coded '0')--is coded '0', '1', '7' or '8' (loose).

c). air pump system - for the purpose of this report, consists of the air pump and the air pump valve and is coded '0' (is aspirated or none), '1', '4'(other than belt removal), '7' or '9'.

I). Exhaust gas recirculation system directs a portion of the exhaust gases back into the cylinders to reduce the amount of NOx in the exhaust gases. The standard EGR configuration consists of a vacuum line from the carburetor to a sensor (used to detect engine operating temperature to activate the EGR valve), and another vacuum line from the sensor to the EGR valve.

a). EGR control valve--is coded '0', '1', '3', '7' or '9'.

b). EGR sensor - is coded '0', '1', '3', '5', '7' or '9'.

J). Vacuum Spark Retard - retarding the spark during idle delays ignition within the combustion chamber and increases the exhaust temperature thereby prolonging the combustion process and reducing HC emissions. Vacuum spark retard is coded '0', '1', '2' or '3'.

APPENDIX C

CLASSIFICATION OF COMPONENT CONDITIONS

The table below is used to classify the various system components as 'tampered', 'arguably tampered', or 'malfunctioning'. Only those codes which are eligible for use with a given component are listed. Codes for 'not orginally equipped' and 'functioning properly' are not included in this table. Refer to page B - 4 for an explanation of the codes.

Component/system	Codes from form						
	2	3	4	5	6	7	9
Dash Label						A	
Tank Cap						A	
Tank Label						A	
Filler Neck Restrictor			T			T	
Catalyst Converter						T	M
Oxygen Sensor	T		T			T	
PCV System		T	T		T	T	
Idle Stop Solenoid	T					T	M
Heated Air Intake		T	A		T	A	M
Evaporative Control System		T	T	T		T	M
Aspirated Air Injection System			T			T	M
Air Pump Belt						T	
Air Pump System			T			T	M
EGR Control Valve		T				T	M
EGR Sensor		T		T		T	
Vacuum Spark Retard	T	T					

T = tampered
A = arguably tampered
M = malfunctioning

APPENDIX D

FUEL SAMPLE COLLECTION AND LABELING PROCEDURES

A fuel sample is taken from each vehicle requiring unleaded fuel. These samples are collected in 4 ounce bottles with a hand fuel pump. Once the sample is drawn, the fuel is replaced with an equivalent amount of unleaded fuel if the driver requests, and the pump is flushed with unleaded fuel.

Each bottle is identified with a stick-on label that has the vehicle identifying survey number on it. The vehicle identifying survey number is the first entry on data forms described in Attachment A.

Prior to shipment from the field, a sample tag with the same identifying number is attached to each bottle. The bottles are packaged, labeled, and shipped to the NEIC Chemistry Branch according to the shippers requirements and the NEIC Policy and Procedures Manual.

APPENDIX E

METHOD OF APPLICATION OF PLUMBTESMO

1) Clean a portion of the inside of the tailpipe large enough for the test paper by wiping it out with a paper towel or cloth. This may be necessary in order to wipe away soot deposits which might mask the color change.

2) Moisten the PLUMBTESMO with distilled water and immediately* press firmly for approximately thirty seconds against the surface to be tested. If the tailpipe is hot you may wish to clamp the test paper in the tailpipe using a clean clamp.

   *Note: The PLUMBTESMO paper must be applied during the time that the paper is yellow for the reaction to take place. After approximately 15 seconds the yellow color disappears and the paper is no longer effective. Excess water also interferes with the reaction.

   Care must be taken to avoid contamination of the test paper. If a person has recently handled a test paper with a positive reaction, some lead or reactive chemical may have been transferred to their fingers. Handling a subsequent clean test paper may cause contamination.

3) After removing the test paper, wait approximately thirty seconds to make a determination. A color change to red or pink splotches indicates the presence of lead.

APPENDIX F

FIELD QUALITY CONTROL/ASSURANCE

Reference and calibration gases were used to assure the accuracy of the emissions measuring instrument. Horiba gases certified by RTP were used as reference gases. Two cylinders of reference gas were used to validate the accuracy of the calibration gases before they were taken to the field on each survey.

Three calibration gases (Horiba) were used. These gases were a mixture of CO and HC in nitrogen and were used to check the instrument at least three times daily. These calibration gases are certified by the manufacturer and the RTP reference gases. Their approximate concentration is:

8% CO

1560 ppm HC (Hexane equivalent)

4% CO

827 ppm HC (Hexane equivalent)

1.6% CO

320 ppm HC (Hexane equivalent)

APPENDIX G

MOTOR VEHICLE TAMPERING SURVEY

RECORD OF NON-PARTICIPATING VEHICLES

Location _____ Date _____

TIME	MAKE	MODEL	YEAR	REASON

Appendix H

1983 tampering and fuel switching rates — by site and I/M program status

Tampering Category	Chicago	Denver	Sedgwick County,KA	Los Angeles	Phoenix	Houston	I/M areas	Non-I/M areas*	All sites
At least one component tampered	27%	23%	24%	16%	27%	34%	24%	29%	26%
Catalytic converter	15	4	7	1	7	9	5	10	7
Filler restrictor	10	4	6	4	13	9	8	8	7
PCV system	4	3	4	2	7	9	5	6	5
Evaporative control system	1	7	2	4	6	8	7	4	5
Air pump system **	7	6	10	7	11	9	9	7	7
EGR system	12	17	14	6	8	19	12	15	13
Fuel switching categories									
Any of three indicators ***	18	10	13	5	15	19	12	17	14
Habitual (leaded fuel or tampered filler)	13	7	9	4	13	13	10	12	10

* Los Angeles rates are not included in the non-I/M category.

** Does not include aspirated systems.

*** Indicators include the presence of leaded fuel in the tank, a tampered fuel filler restrictor, and a positive plumbtesmo tailpipe test for lead deposits.